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THE ANT LARVAE OF THE MYRMICINE TRIBE PHEIDOLINI

(HYMENOPTERA, FORMICIDAE)[1]

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The tribe Pheidolini comprises 18 genera: *Stenamma, Sifolinia, Aphaenogaster, Novomessor, Veromessor, Messor, Goniomma, Oxyopomyrmex, Machomyrma, Pheidole, Ceratopheidole, Ischnomyrmex, Epipheidole, Sympheidole, Parapheidole, Conothoracoides, Gallardomyrma* and *Ancyridris.* It includes harvesting ants (*Messor, Veromessor, Goniomma, Oxyopomyrmex, Pheidole*); species with a strongly polymorphic or dimorphic worker caste (the soldiers with enormous heads) (*Messor, Machomyrma, Ischnomyrmex, Ceratopheidole, Pheidole*); and permanent social parasites (*Sympheidole, Epipheidole, Sifolinia*). There are about 500 species in the tribe, most of which (391 according to the *Genera Insectorum*) are in *Pheidole,* which is, in fact, the second largest genus of ants. "One species, *Pheidole megacephala,* has been carried to all parts of the tropics and has become a great pest in and about dwellings and plantations as it assiduously cultivates coccids on many economic plants and ruthlessly destroys and replaces the native ant-faunas" (Wheeler, Bull. Amer. Mus. Nat. Hist. 45: 128. 1922).

In this article we have described the larvae of 22 species representing six genera. References from the literature are cited for 22 additional species, making a total of 44 species considered.

Our pheidoline larvae are a heterogeneous group which we have found difficult to characterize as a tribe. They differ little (as a group) from the Myrmicini but are perhaps somewhat more specialized as to body shape, mandibles, spinules on the mouth parts and body hairs. As with the adults, *Stenamma* is the most primitive genus and *Ischnomyrmex* the most specialized.

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Tribe **PHEIDOLINI** Emery

Moderately stout or plump and chunky; neck short or wanting. Body hairs sparse to moderately numerous; mostly short; of 1-3 types; shapes diverse. Spiracles all small, the mesothoracic slightly larger. Antennae small, each with two or three sensilla, each of which bears a spinule. Head hairs few or moderately numerous; short to rather long; shapes diverse. Labrum typically bilobed; short (breadth 2-2½× length); ventral border bearing 4-10 sensilla and usually spinulose; posterior surface spinulose, the spinules minute and mostly in rows. Mandibles small to moderate-sized [ratio of head width to mandible length—2.2-3.3 (average 2.9)]; ratio of length to width (at base)—1.4-2.4 (average 2); moderately sclerotized; apical tooth slender, curved medially; two or three stout medial teeth (except in *Messor*); with some portion of the surface spinulose (except in *Novomessor*). Maxillary palp usually short and bearing 5 sensilla; galea longer and slender. Anterior surface of labium usually spinulose; palp a low elevation bearing five sensilla; opening of sericteries an inconspicuous transverse slit. Hypopharynx with minute spinules arranged in rows and usually also with sublongitudinal ridges.

Genus **Stenamma** Westwood

Moderately stout; constricted slightly at the first abdominal somite; thorax turgid; abdomen swollen; no neck. Submature larva shaped somewhat like a crook-neck squash; thorax and first abdominal somite forming a short stout neck, which is curved ventrally; remainder of abdomen subellipsoidal. Body hairs moderately numerous and rather short; bifid; the tip of each branch may be bifid or denticulate. Head moderately large. Head hairs moderately numerous, rather long, 2-4-branched, usually bifid, rarely denticulate. Posterior surface of labrum spinulose, the spinules minute and mostly in short arcuate rows which form a reticulate pattern, a few isolated near the lateral borders. Mandibles with the apex forming a moderately long slender tooth which is curved medially; two rather stout medial teeth; medial surface of basal half with several short coarse spinules. Maxillae with the apex spinulose; palp a short stout peg with two large contiguous apical sensilla, two small discoidal apical sensilla (each bearing a short spinule) and one lateral sensillum (bearing a very long spinule). Dorsal portion of hypopharynx with sublongitudinal ridges; ventral spinulose, the spinules minute and arranged in rows which form a reticulate pattern.

Stenamma diecki Emery

(Pl. I, figs. 1-13)

Body moderately stout; slightly constricted at the first abdominal somite; thorax turgid; abdomen swollen; diameter greatest at the fourth abdominal somite. No neck. Anus posteroventral. Leg, wing and gonopod vestiges present. Eight differentiated somites. Spiracles small,

the first slightly larger. Integument of ventral surface of thorax and first abdominal somite with a few minute spinules in short to moderately long subtransverse rows. Body hairs moderately numerous and rather short (0.036-0.11 mm). All body hairs bifid; branches very short to more than half the total length of the hair; each branch may also be bifid at the tip and may be furnished with denticles. Head moderately large. Cranium subhexagonal in anterior view; slightly broader than long. Antennae small; with three sensilla each. Head hairs moderately numerous, rather long (0.054-0.09 mm), 2-4-branched, usually bifid, rarely denticulate. Labrum short (breadth nearly 2½× length), bilobed, narrowed dorsally; anterior surface of each lobe with five sensilla (each bearing a spinule); ventral border of each lobe with two contiguous sensilla and several spinules; posterior surface of each lobe with about five isolated and a cluster of 2-3 contiguous sensilla; posterior surface spinulose, the spinules minute and mostly in short arcuate rows which form a reticulate pattern, a few isolated near the lateral borders. Mandibles moderately sclerotized; subtriangular in anterior veiw; apex forming a moderately long slender tooth which is curved medially; two rather stout medial teeth; medial surface of basal half with several short coarse spinules. Maxillae with the apex paraboloidal and spinulose, the spinules minute and in short arcuate rows; palp a short stout peg with two large contiguous convex apical sensilla, two small discoidal apical sensilla (each bearing a short spinule) and one lateral sensillum (bearing a very long spinule); galea digitiform, with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and in short transverse rows; palp a low elevation with two large contiguous convex sensilla, two small discoidal sensilla (bearing each a short spinule) and one small discoidal sensillum (bearing a long spinule); opening of sericteries a short transverse slit on the anterior surface. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinulose minute and arranged in rows which form a reticulate pattern.

Submature.—Shaped somewhat like a crookneck squash, the thorax and first abdominal somite forming a short stout neck which is curved ventrally; remainder of abdomen subellipsoidal. Anus ventral. Otherwise as in the mature larva.

Young.—Length 1.6 mm. Thorax and first abdominal somite forming a short stout neck which is strongly arched ventrally; rest of abdomen somewhat swollen. Anus ventral, with a posterior lip. Body hairs similar in shape to those of adult; moderately numerous on thorax and abdominal somite I, very few on II and III and none elsewhere. Head hairs few, short and simple. Otherwise as in the mature larva.

Material studied: Numerous larvae from Michigan and North Dakota.

Stenamma sp.

Apparently similar to *diecki* except that the body hairs are shorter (0.027-0.081 mm long), less numerous and with shorter branches; head

hairs also shorter (0.036-0.063 mm long), less numerous and with shorter branches; mandibles with the teeth stouter and blunter. (Material studied: numerous damaged larvae labeled "Cloudcroft, New Mexico, 9000 ft., July 7, 1917".)

Stenamma westwoodi Westwood

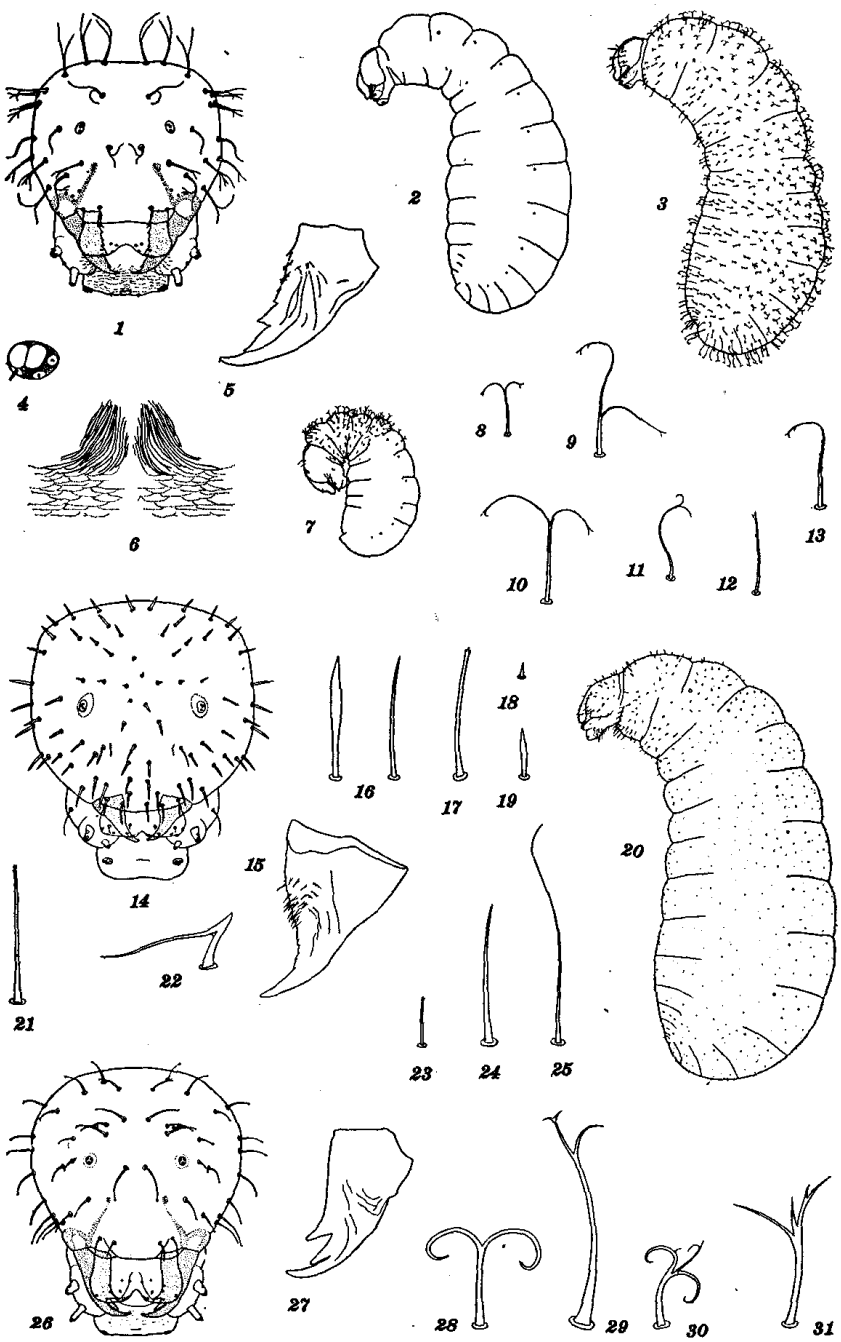
Donisthorpe, 1922, p. 2: The workers in an artificial nest "have a curious habit, when . . . the colony [is] disturbed by being exposed to light, of rushing at a larva, seizing it, and apparently giving it a good shaking up! I have found when touched that a larva will exude a drop of thick white fluid; it is probable that this is a means of defense, and possible that the worker shakes up a larva to induce it to discharge this fluid. These ants devour flies and other insects readily, with bits of which they feed the larvae, as also with crumbs of cake and biscuits. . . .

"*Larvae.*—Grayish white, head pale yellow, mandibles reddish; covered *all over* with short anchor-tipped golden hairs. Plainly segmented to within a third of the posterior end; the head and 3 thoracic somites bent over posteriorly towards the ventral surface. Head flat, rounded, with short very pointed mandibles; abdomen pyriform. [This paragraph repeated 1927, p. 153.]

"The larva is semi-transparent under the microscope, part of the alimentary canal, breathing apparatus, and nervous system being visible through the skin from the dorsal and ventral aspects; but not nearly so plainly through the sides. At the ventral posterior end of the body, a white opaque mass can be seen through the skin, which is evidently of a liquid consistency, as when the larva is touched with a paint brush, a thick white drop of fluid is exuded from the anus, which either evaporates very quickly, or is partly received back into the body, leaving a thick white coating of the consistency of 'Chinese White' on the anal surface of the larva."

PLATE I. LARVAE OF PHEIDOLINI

Stenamma diecki Emery, figs. 1-13—1, head in anterior view, ×76; 2, submature larva in side view (hairs omitted), ×20; 3, mature larva in side view, ×20; 4, right labial palp in anterior view, ×433; 5, left mandible in anterior view, ×185; 6, hypopharynx in anterior view, ×185; 7, young larva in side view, ×20; 8-13, six body hairs, ×185. *Messor barbarus* (Linnaeus), figs. 14-20—14, head in anterior view, ×67; 15, left mandiple in anterior view, ×170; 16, two views of a lanceolate hair from the ventral surface of the prothorax, ×185; 17, a hair from the ventral surface of the prothorax, with frayed tip, ×185; 18, a hair from the dorsal surface of the abdomen, ×185; 19, a hair from the dorsal surface of the prothorax, ×185; 20, larva in side view, ×16; *Messor barbarus striaticeps* Ern. André, Figs. 21-25—21, typical head hair, ×185; 22, atypical head hair, ×185; 23-25, three body hairs, ×185. *Novomessor albisetosus* (Mayr), Figs. 26-31—26, head in anterior view, ×57; 27, left mandible in anterior view, ×118; 28-31, four body hairs, ×185.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Genus **Aphaenogaster** Mayr

Bernard, 1948: The abdomen has 6-8 visible sutures (p. 179). "*Aphaenogaster*, et tous les Myrmicinés primitifs, paraissent avoir des larves sans poils crochus ni poils en pinceau" (p. 180).

Gantes, 1949: "Très agiles" (pp. 84 and 88). Growth p. 85. "Chez les larves très agiles comme *Aphaenogaster* les mandibules sont grandes, bien formées et servent à mastiquer. J'ai vu ces larves mordre seules de la viande fraîche que les ouvrières avaient posée près d'elles. Ces larves sont primitives" (p. 88).

Wheeler, 1928*a*, p. 202: "The larvae may be given crude pieces of insects" (=1926, p. 243).

Subgenus **Attomyrma** Emery

Moderately stout; constricted slightly at the first abdominal somite; thorax turgid; abdomen swollen; no neck. Submature larva with its diameter greatest at abdominal somites IV and V, diminishing anteriorly; anterior end bent ventrally; no neck; posterior and broadly rounded. Body hairs moderately numerous and rather short. Of two types: (1) with long stout base and short dichotomizing tip, on the thorax and abdominal somites I, IX, and X; (2) with short base and long flexible dichotomizing branches, on abdominal somites I-VIII; intergrades rare. Head hairs moderately numerous and rather long. Of two types (1) simple and (2) with bifid tip. Posterior surface of labrum densely spinulose, the spinules minute and in short arcuate rows which tend to form a reticulate pattern. Apex of mandible forming a rather slender tooth which is slightly curved medially; two stout round-pointed medial teeth; medial surface of basal half with several short to very long

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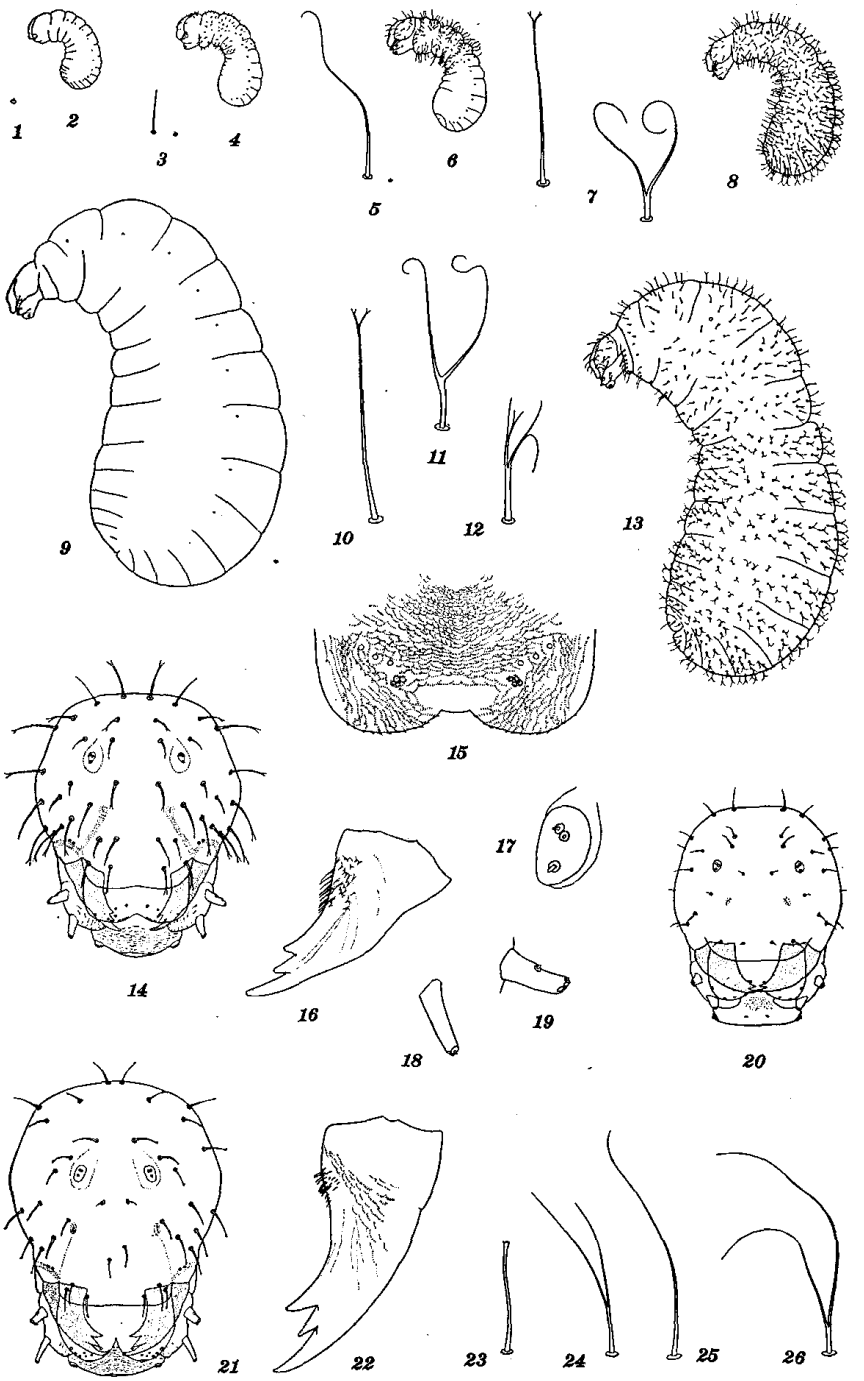
PLATE II. LARVAE OF PHEIDOLINI

Aphaenogaster (*Attomyrma*) *rudis* Emery, figs. 1-20—1, a body hair of first instar larva, ×190; 2, first instar larva in side view, ×16; 3, two body hairs from second instar larva, ×190; 4, second instar larva in side view, ×16; 5, two body hairs from third instar larva, ×190; 6, third instar larva in side view, ×16; 7, two body hairs from fourth instar larva, ×190; 8, fourth instar larva in side view, ×16; 9, submature (hairs omitted), ×16, 10-12, three body hairs from mature larva, ×190; 13, mature larva in side view, ×16; 14, head in anterior view, ×76; 15, labrum in posterior view, ×173; 16, left mandible in anterior view, ×173; 17, right antenna in anterior view, ×347; 18, left galea in anterior view, ×173; 19, left maxillary palp in anterior view, ×173; 20, head of second instar larva in anterior view, ×76. *Aphaenogaster* (*Deromyrma*) *araneoides inermis* Forel, figs. 21-26—21, head in anterior view, ×67; 22, left mandible in anterior view, ×188; 23, a hair from the ventral surface of the thorax, ×190; 24, a hair from the dorsal surface of the thorax, ×190; 25, a hair from the ventral surface of the abdomen, ×190; 26, a hair from the dorsal surface of the abdomen, ×190.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spinules. Maxillae with the apex spinulose; palp digitiform. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and arranged in rows which form a reticulate pattern.

Aphaenogaster (Attomyrma) rudis Emery

(Pl. II, figs. 1-20)

Mature.—Length about 4.2 mm. Body moderately stout; slightly constricted at the first abdominal somite; thorax turgid; abdomen swollen; diameter greatest at the fourth and fifth abdominal somites. No neck. Anus posteroventral. Leg, wing and gonopod vestiges present. About seven differentiated somites. Spiracles small, the mesothoracic slightly larger. Integument of the ventral surface of the thorax and first abdominal somite and the dorsal surface of the posterior somites spinulose, the spinules minute and in short to moderately long subtransverse rows. Body hairs moderately numerous and rather short. Of two types: (1) with long stout base and short dichotomizing tip, on the thorax and abdominal somites I, IX and X, 0.07-0.12 mm long; (2) with short base and long flexible dichotomizing branches, on abdominal somites I-VIII, 0.07-0.14 mm long; intergrades are rare. Cranium subhexagonal in anterior view; as long as broad. Antennae small, with three (rarely two) sensilla each. Head hairs moderately numerous, rather long (0.036-0.072 mm), simple or with the tip bifid. Labrum short (breadth 2X length), bilobed; anterior surface of each lobe with 4-6 sensilla and a few minute spinules; ventral border of each lobe with an isolated and two contiguous sensilla and a few short rows of minute spinules; posterior surface of each half with three isolated and a cluster of four sensilla; posterior surface densely spinulose, the spinules minute and in short arcuate rows which tend to form a reticulate pattern. Mandibles moderately sclerotized; subtriangular in anterior view; apex forming a long rather slender tooth which is slightly curved medially; two stout, round-pointed medial teeth; medial surface of basal half with several short to very long spinules. Maxillae with the apex paraboloidal and spinulose, the spinules minute and in short arcuate rows; palp digitform with four apical and one lateral sensilla; galea digitform with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and in short arcuate rows; palp a low elevation bearing five sensilla; opening of sericteries a short transverse slit hidden in a shallow furrow on the anterior surface of the labium. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and arranged in rows which form a reticulate pattern.

Submature.—Length about 4.3 mm. Diameter greatest at abdominal somites IV and V; diminishing anteriorly; anterior end bent ventrally; no distinct neck; posterior end broadly rounded. Otherwise very similar to the mature larva.

First Instar Larva.—Length about 0.95 mm. Stout, C-shaped, terete, diameter nearly uniform but greatest at abdominal somites IV and V.

Practically naked, hairs sparse on the head, thorax and first abdominal somite, very few elsewhere; exceedingly minute (about 0.001 mm long).

Second Instar Larva.—Length about 1.1 mm. Similar to first instar larva but with the addition of short (0.006-0.056 mm) simple hairs on head, thorax and abdominal somite I.

Third Instar Larva.—Length about 1.3 mm. Similar to the second instar larva, except that the hairs of the longer type are flexible, more conspicuous and relatively longer (0.036-0.11 mm) and occur as far back as abdominal somite II.

Fourth Instar Larva.—Length about 1.8 mm. Body shape similar to that of third instar larva but more slender. Body hairs similar to those of adult but shorter (about 0.1 mm long) and seemingly more abundant.

Material studied; numerous larvae from Massachusetts, Michigan, New Hampshire and New York.

Park, 1933*b*, p. 258: The ptiliid beetle *Limulodes paradoxus* Matthews feeds on surface oils and sundry accumulations of the integument of the ant brood. The larvae seem unhurt by the scraping.

Talbot, 1951, p. 303: The average number of larvae per nest was 160.56. Larvae overwintered in the nests.

From the notebook of G. C. Wheeler, 1920: April 11—The convex under surface of a fly's abdomen has been applied to the head of one of the queen larvae and it remains there when the larva is moved about the nest. A small larva has a smaller piece of fly; another queen larva has a mutilated *Lasius* larvae on its head. May 10—The workers seem very "affectionate" toward their larvae. Apparently they "like" to take larvae in their mandibles to the glass cover of the artificial nest and remain there for hours. Today I observed that a queen larva was held in this manner by two workers, one at either end. A third worker was usually in attendance standing beside the larva and facing it. May 28—This evening I isolated two queen larvae in a petri dish. Laying them on their backs I placed on the belly of each the abdomen of a freshly killed termite with the cut end pressed against the mandibles of the larva. May 30—Nothing remains of the termite abdomens except the dried skins, one still lying on an ant larva, the other nearby.

Aphaenogaster (Attomyrma) rudis picea Emery

Fielde, 1901, p. 431-433: "The feeding of the larva, which is bent nearly double in the egg, with regurgitated food begins as soon as it straightens itself and protrudes its mouth. When the larvae begin to appear in the egg-packet, the workers lift the packet and hold it free and still, while one of their number holds a translucent white globule of regurgitated food to the larval mouth projecting from the surface of the egg-packet. I have repeatedly seen the workers thus feeding the very young larvae, a single globule of regurgitated food serving for a meal of which four or five larvae successively partook.

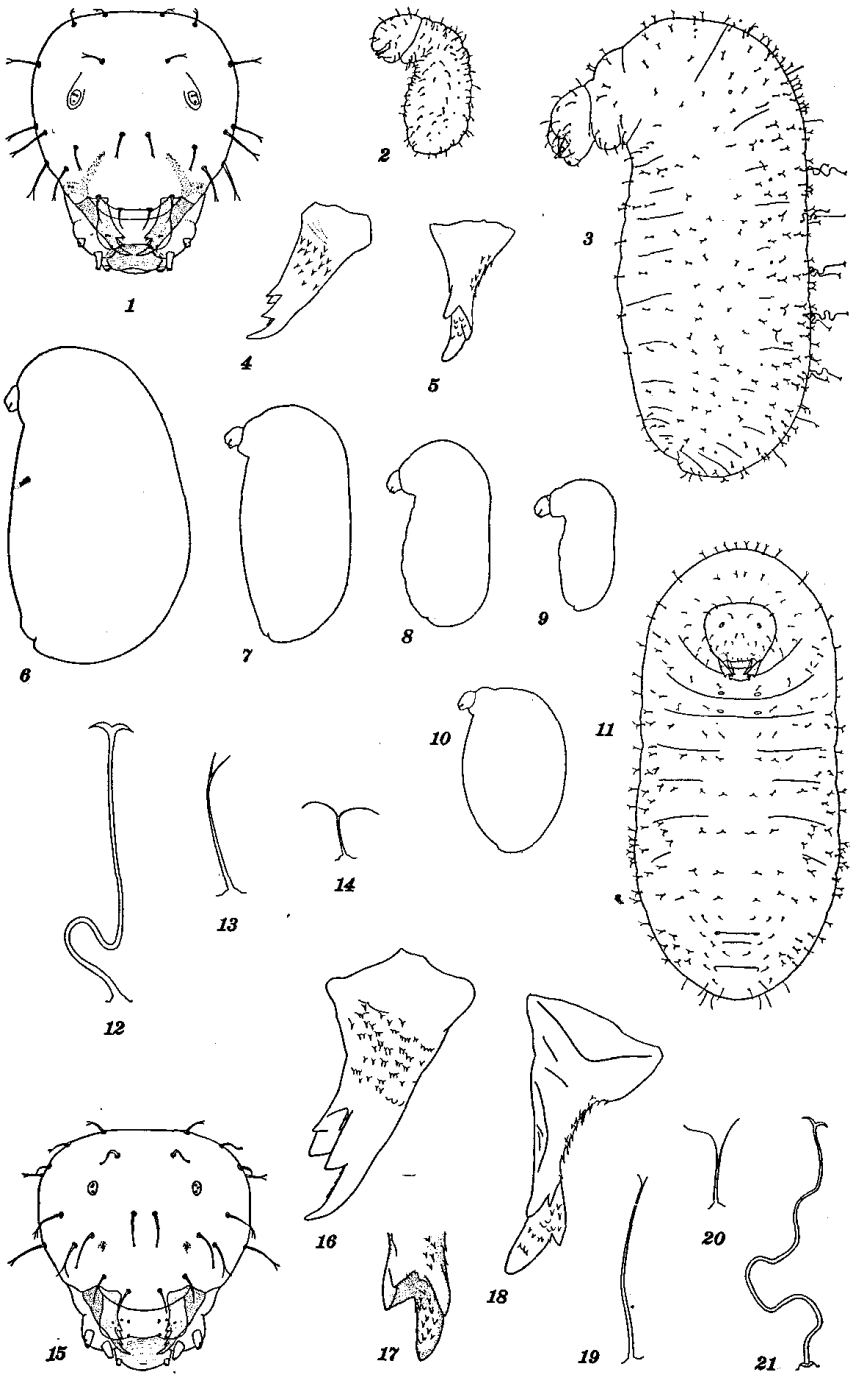
"When the larva first emerges, its length is nearly double that of the egg. When well fed its growth is rapid and in a day or two its length is

three or four times that of the egg. When about two millimeters long it is usually removed from the egg-packet and laid on the floor, or associated with others of its size in a separate bundle, the individuals being fastened together by the hooks on their surfaces, as the eggs were by their sticky shells. The habit . . . of assorting the young in accordance with the size and form, doubtless economizes labor and also tends to the preservation of the young. The flexible neck of the larva enables it to reach to a distance equal to a quarter of its body-length, and to fix its mouth upon anything edible that is within its reach. I have observed a gradual diminution of the eggs in every cell where the smallness of the working force prevented that segregation of the larvae and that assortment according to size which prevails in large communities; and I have also, in such circumstances, seen full-grown larvae, and even pupae, fall victims to the voracity of the unfed younger larvae.

"The older larvae are often fed when lying upon their backs, the ventral side serving as a place of deposit for food reached by the curving of the neck. . . . But this feeding posture is . . . scarcely more common than are others. Sometimes one larva is used as a table, not only for its own feeding, but for the feeding of two or three other larvae that are inclined against its sides to take their portion of the same morsel. I have also seen five larvae set on end around half the abdomen of a bisected house-fly, feeding voraciously from its interior, like pigs around a trough. Sometimes the larva is laid with its ventral side against a succulent portion of the insect, and is left there to take its fill; sometimes it has a portion of meat held to its mouth and forcibly removed as soon as it has had a brief repast, and sometimes a worker stands with her head over that of the larva and allows it to take food from her crop in a manner resembling that in which a mother-pigeon feeds her young. In my nests the very young larvae have been fed solely upon regurgitated food. The older larvae have been given particles of flies, mealworms, roaches, beetles, spiders, sponge-cake, white bread moistened with sweetened water, and of dried yolk of hens' eggs. They have also fed upon fragments of ants of other species, on pupae of alien colonies, and on the pupae and larvae of *Crematogaster lineolata* and of *Lasius umbratus*.

PLATE III. LARVAE OF PHEIDOLINI

Pheidole dentata Mayr, figs. 1-14—1, head in anterior view, ×105; 2, very young larva in side view, ×31; 3, mature worker larva in side view, ×31; 4, left mandible in anterior view, ×202; 5, left mandible in medial view, ×202; 6, profile of queen larxa, ×9; 7, profile of male larva, ×9; 8, profile of soldier larva, ×9; 9, profile of worker larva, ×9; 10, profile of immature sexual larva, ×9; 11, mature worker larva in ventral view, ×31; 12-14, three body hairs from worker larva, ×185. *Ischnomyrmex longipes* (F. Smith), figs. 15-21—15, head in anterior view, ×71; 16, left mandible in anterior view, ×216; 17, tip of left mandible in anteromedial view, ×216; 18, left mandible in medial view, ×216; 19-21, three body hairs, ×95.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"Larvae deprived wholly of insect food did not during a period of one hundred days produce one pupa. But larvae grew from the egg to nearly full size without insect food, and one pupa, that later on became a minim, had no insect food during the last twenty-two days of its larval stage." (First paragraph quoted by Wheeler and Bailey, 1920, p. 250.)

Wheeler, 1900*b*, p. 66: "One afternoon Miss Fielde left a lot of queen pupae and larvae of *Crematogaster lineolata* within reach of the [*Aphaenogaster*] colony. By the following morning the [Aphaenogasters] had carried these into their nest, cut off their heads and abdomens, and had distributed the pieces freely among the larvae, which could be seen singly and in groups of from two to five eagerly feeding on the juices in the same manner as Ponerine larvae. Thinking that this might be a very exceptional action, due to the confinement of the colony, I opened numerous nests in the woods during the month of August, while the ants were rearing their second brood. In nearly every one of these nests I found one or more larvae feeding on substances left among them by the workers. In one nest three larvae were feeding on a small Geometrid caterpillar; in another several had their heads and necks inserted into the thoraces of some small Carabid beetles that had been decapitated by the ants; in still another nest several larvae were devouring the pulp of a blackberry, etc." (Referred to by Wheeler, 1933, p. 15 and by Wheeler and Bailey, 1920, p. 251.)

Aphaenogaster (Attomyrma) famelica (F. Smith)

Generally similar to the young of *rudis*. (Material studied: integuments of five young larvae from Japan.)

Aphaenogaster (Attomyrma) fulva Roger

Park (1933*a*, p. 150) has reported that the pselaphid beetle *Tmesiophorus costalis* Lec. feeds on the brood of this ant.

Aphaenogaster (Attomyrma) gemella (Roger)

Gantes, 1949: "Chez une larve au premier stade le corps est en forme de poire: abdomen plus large que la tête. Le corps est légèrement arqué; seuls les segments thoraciques sont bien séparés. La tête est presque aussi large qu'eux. Le corps est nu. La tête est bien différenciée, mais les diverses parties sont à peine visibles, car transparentes. Les mandibules, 0 mm. 078, sont claires: ce sont de petits triangles aigus à l'apex, et sur un côté se notent deux minuscules dents. La larve au 5e stade a un peu la forme d'une haltère dont les segments thoraciques formeraient la barre médiane, et la tête plus le premier segment d'une part et l'abdomen d'autre part, seraient les boules. Les segments sont séparés par de profondes constrictions. Tout le corps est couvert de poils clairsemés de plusieurs types: 1. *Poils bifurqués* à leur extrémité, légèrement arqués, de 0 mm. 142, répartis sur le prothrax et ventralement. 2. *Poils bifurqués* plus courts, 0 mm. 115, droits et brusquement repliés à la hauteur de la

fourche. Sur le bout de l'abdomen on retrouve ces poils fourchus mais beaucoup plus longs: 0 mm. 18. 3. *Poil coudé* à 90° à la moitié de sa longueur et se terminant par deux branches plus longues que dans les autres cas. La tête, petite, très mobile, est bien différenciée, beaucoup plus haute que large. Elle est couverte de poils, 42, répartis symétriquement. On retrouve les mêmes pièces buccales. Le labre est formé par deux lobes identiques, séparés par une échancrure profonde laissant voir la pointe des mandibules. Ventralement, sur chaque lobe on trouve trois sensilles accolées ensemble près de l'échancrure et une isolée plus à l'extérieur. Dorsalement on a deux minuscules poils. Les mandibules sont grandes, 0 mm. 161, brun foncé. Ce sont des triangles qui s'insèrent dans la tête par deux parties plus épaissies et arrondies ressemblant à une articulation, dont l'apex est une dent longue et fine sur laquelle se branchent deux autres dents plus fines. Les dents sont foncées, la base plus claire. Chez une larve due 3^{e} stade, les poils sont plus variés. Sur la tête on a deux types de poils: 1. *Poils épineux:* ce sont des poils à deux branches qui sont couverts d'épines. Ces poils mesurent 0 mm. 023. 2. *Poils* de la même longueur, se divisant en deux branches qui n'ont d'épines qu'à l'intérieur. Sur le corps, nous avons des poils épineux du même genre, mais plus longs, 0 mm. 05'' (pp. 78-79). ''Les poils varient non seulement au point de vue quantité, mais aussi de forme et de taille au cours de la croissance. Prenons le cas d'*Aphaenogaster gemella,* qui est assez primitive. La larve néonate est nue. Au II^{e} stade les poils apparaissent sur la tête et le prothorax assez serrés et sur les deux segments suivants plus clairsemés, ils sont épineux. Au III^{e} stade les poils sont répartis sur tout le corps, très abondants. Sur la tête ce sont des poils bifurqués épineux de l'ordre de 0 mm. 023; sur le corps, ils sont de deux types; poils épineux comme sur la tête, mais de 0 mm. 05 et des poils à double crochet de même taille. Au stade IV les poils épineux sont plus espacés et on trouve quelques poils bifurqués semblables à ceux du stade V'' (p. 87). Growth data p. 86. Pl. III, Fig. I, mature and young larvae and hairs; Pl. IV, md 1, mandible.

Aphaenogaster (Attomyrma) subterranea (Latreille)

Gösswald (1934/35, p. 125) has recorded this ant as a mermithid host. Presumably the nematode larvae were parasitic in the ant larvae.

Aphaenogaster (Attomyrma) subterranea occidentalis Emery

Apparently similar to *rudis.* (Material studied: two damaged integuments from Montana.)

Aphaenogaster (Attomyrma) tennesseensis (Mayr)

Apparently similar to *rudis* except as follows: head hairs with multifid tips; mandibular teeth more acute; spinulose area of mandibles larger. (Material studied: five damaged integuments from Missouri.)

Peterson, 1948, Pl. H12, fig. F: ''*Aphaenogaster* (prob.) *tennesseensis*

Mayr . . .F. g.l. [full grown larva or length] 3.5 mm. Lateral view of a dirty white somewhat pear-shaped larva with a very small, well developed head; most of the setae on the head and body appear to be bifurcate.'' Larva in side view; head enlarged in anterior view; two hairs enlarged.

Aphaenogaster (Attomyrma) texana Emery

Similar to *rudis* except that the head hairs have multifid tips. (Material studied: eight larvae from Arkansas.)

Aphaenogaster (Attomyrma) treatae pluteicornis
G. C. and E. W. Wheeler

Both young and mature are similar to *rudis*. (Material studied: a dozen larvae from Oklahoma.)

Aphaenogaster (Attomyrma) sp.

Similar to *rudis* except that the longer head hairs are 2-4-branched and the shorter hairs simple. (Material studied: numerous larvae collected by G. C. Wheeler, Michigan #4; identified by Dr. M. R. Smith as ''*fulva* complex''.)

Aphaenogaster (Aphaenogaster) simonellii Emery

Menozzi, 1936: ''*Larva matura dell'operaia*--Colore bianco sporco, col capo cremeo-flavo, le mandibole ferruginee, le setole umbrine. La forma del corpo è subclaviforme, cioè con una porzione anteriore stretta e subcilindrica e coi segmenti abbastanza distinti, ed una parte posteriore rigonfiata in cui i limiti dei segmenti sono meno netti. Il cranio visto dal dorso è pressapoco così lungo che largo, a contorni arrotondati e fornito di numerose setole . . . Le antenne sono rappresentate da due placchette ovali, fornite ciascuna da tre minuti sensilli. Il clipeo è fortemente trasverso e appena distinto dalla fronte retrostante da un leggero ispessimento più chitinizzato, il quale non raggiunge i lati; anteriormente esso ha il margine subtroncato ed è fornito, a ciascuno dei lati della linea medio-longitudinale, di due setolette. Il labbro superiore è pure trasverso, con gli angoli anteriori ampiamente rotondati e col margine libero profondamente incavato nel mezzo; dorsalmente esso è provvisto di varie setolette e di tre sensilli circolari posti lungo il margine anteriore, ai lati della incavatura. Le mandibole sono fortemente chitinizzate e lunghe circa due volte la loro massima larghezza, tridentate, col dente apicale del doppio più lungo di quello più prossimale. Le mascelle, con le parti che le costituiscono, poco differenziate; la porzione anteriore mostra i lati diritti coll'apice arrotondato e fornite ognuna di due vistose formazioni chitinizzate in forma di articolo subconico di cui, l'una, l'esterna, è da riferirsi al palpo mascellare e l'altra, seguendo per ora il Grandi, indico col nome di processo distale della mascella. Il labbro inferiore, veduto dorsalmente, ha il margine anteriore e i lati diritti, coi palpi, posti in prossimità degli angoli anteriori, cortis-

simi, cupoliformi, e forniti, ognuno, distalmente, di quattro sensilli papilliformi. Ciascun segmento del corpo, nella larva di media età (lungh. mm. 2, 8), è provvisto lateralmente di 3-5 setolette bifide all'apice . . . inoltre, dorsalmente e ventralmente, rispettivamente, di 3 e 2 setole molto più lunghe, anch'esse bifide all'apice e per le quali propongo il nome di aptochete. . . Dette setole scompaiono tutte, o quasi, allorchè la larva ottiene lo stadio che precede quello di ninfa. Il sistema tracheale è olopneustico, con 10 paia di piccoli spiracoli tracheali; due paia nel torace e otto paia nell'addome, situati anteriormente nella regione pleurale di ciascun segmento. Lunghezza della larva matura mm. 3, 6" (pp. 273-275). Fig. V on p. 274: mature larva in side view; head in anterior and side views enlarged; hair enlarged; mandible enlarged. Menozzi called this ant *A. s.* var. *balcanica* Emery.

Aphaenogaster (Aphaenogaster) testaceopilosa (Lucas)

Athias-Henriot, 1947: "Le corps est en forme de poire et arqué (la courbure s'étend depuis le thorax jusqu'aux premiers segments abdominaux). La partie postérieure de l'abdomen est très volumineuse et la tête très petite—quoique très bien différenciée—les segments thoraciques sont très étroits. On trouve sur la tête tous les éléments, en particulier les mandibules pointues à longues branches d'insertion. On peut parfois voir le tube chitineux spiralé par transparence, dans le labium. Il y a sept segments abdominaux, trés nettement séparés par de profondes constrictions. Le corps est uniformément couvert de grands macrochètes simples clairsemés. La cuticule est un peu chagrinée (peut-être artefact). L'anus est bien visible. Les stigmates sont en entonnoir" (p. 252). Internal anatomy: pp. 254, 257, 259, 260, 263, 264, 266, 267 and Fig. 3.

Aphaenogaster (Aphaenogaster) testaceopilosa spinosa Emery

Emery, 1918: "Nel corso dell'estate, molte larve crebbero notevolmente e si avviavano a diventar femmine. A quanto pare, queste larve erano esclusivamente alimentate per degurgito, mentre le larve di operaia, quando avevano raggiunto una certa dimensione ed erano staccate dai cumuli di piccole larve, mangiavano anche frammenti d'insetti che le operaie distribuivano loro" (p. 68). "Pare che le larve destinate a svilupparsi in femmine vengono alimentate dalle operaie per degurgito, all'opposto delle larve di operaie." (p. 69).

Subgenus **Deromyrma** Forel

Similar to *Attomyrma* except in the following characters: Body hairs of three types: (1) short, stout, with frayed tip, on abdominal somites IX and X and on the ventral surface of the thorax; (2) long, simple, with distal half slender and flexible, on the ventral surface of the abdomen; (3) bifid, long, with the branches long and slender, on the dorsal and lateral surfaces. Head small. Head hairs few, rather short, with stout base and denticulate tip. Maxillary palp a skewed peg. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in subtransverse rows.

Aphaenogaster (Deromyrma) araneoides inermis Forel

(Pl. II, figs. 21-26)

Body moderately stout; slightly constricted at the first abdominal somite; thorax turgid; abdomen swollen; diameter greatest at the fifth abdominal somite. No neck. Anus posteroventral. Leg, wing, and gonopod vestiges present. About seven differentiated somites. Spiracles small, the first slightly larger. Integument on the ventral surface of the thorax and abdominal somite I spinulose, the spinules minute and in subtransverse rows of various lengths. Body hairs moderately numerous and rather short. Of three types: (1) short (0.043-0.07 mm), stout, with frayed tip, on abdominal somites IX and X and on the ventral surface of the thorax; (2) long (0.07-0.14 mm), simple, with distal half slender and flexible, on the ventral surface of the abdomen; (3) bifid, long (0.09-0.18 mm), with the branches long and slender, on the dorsal and lateral surfaces. Head small; cranium subhexagonal in anterior view; breadth about equal to the length. Antennae small, with three sensilla each. Head hairs few, rather short, (0.036-0.09 mm), with stout base and denticulate tip. Labrum rather large, bilobed; anterior surface of each lobe with 7-9 sensilla; on and near the ventral border of each lobe are arcuate rows of minute spinules and two clusters of 2-3 sensilla and a single sensillum; posterior surface densely spinulose, the spinules minute and in short arcuate rows which tend to form a reticulate pattern. Mandibles moderately sclerotized; subtriangular in anterior view; apex forming a long rather slender tooth which is slightly curved medially; two stout round-pointed medial teeth; medial surface of basal half with several short to long spinules; anterior surface of basal half with several oblique rows of minute spinules. Maxillae with the apex paraboloidal and spinulose, the spinules minute and in short arcuate rows; palp a skewed peg with four apical and one lateral sensilla; galea digitiform with two apical sensilla. Labium with the anterior surface spinulose, the spinules minute and in short arcuate rows; palp a low elevation with five sensilla; opening of sericteries a transverse slit. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in subtransverse rows.

Immature Larva.—Length 3 mm. Shaped somewhat like a crookneck squash; thorax and abdominal somites I-III forming a long stout neck which is strongly arched ventrally; rest of abdomen swollen; diameter greatest at the sixth abdominal somite. Anus ventral. Otherwise similar to the mature larva.

Material studied: several young and one mature larvae from Panama Canal Zone collected by G. C Wheeler, No. 308.

Aphaenogaster (Deromyrma) sp.

Immature Larva.—Length 3.8 mm. Similar to immature *inermis* except as follows: Body hairs short, three times as numerous. Of three types: (1) bifid, 0.07-0.11 mm long, with short base and flexible branches, the most abundant type, distributed from the mesothorax through abdo-

minal somite IX; (2) with stout base and a few apical denticles, 0.024-0.07 mm long, on the thorax, abdominal somites IX and X and ventral surface of abdominal somite I; (3) a few simple, minute (about 0.009 mm long), scattered hairs. (Material studied; seven larvae from Panama collected by G. C. Wheeler, No. 185; near *phalangium*.)

One of the above larvae has a eucharid planidium attached to the integument on the dorsal surface in the suture between prothorax and mesothorax.

Genus **Messor** Forel

Stout. Thorax curved ventrally. Body hairs sparse; minute to very short; of three types. Head moderately large. Head hairs moderately numerous; short. Posterior surface of labrum spinulose, the spinules arranged in short arcuate rows which tend to form a reticulate pattern. Mandibles small; apex slender and curved medially; no medial teeth; basal half of medial surface bearing several long spinules; anterior and posterior surfaces with a few rows of minute spinules. Maxillae not spinulose; galea a slender frustum. Labium not spinulose. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in subtransverse rows.

Bischoff, 1927, p. 122: "Die körnersammelnden *Messor*-Arten ernähren ihre Larven entweder mit dem Inhalt des Kropfes oder einer aus den Körnern hergestellten halbflüssigen Paste."

Emery, 1921, p. 68: "Ces fourmis mangent les graines, elles dissolvent l'amidon cru au moyen de leur salive et se nourrissent et nourrissent leurs larves de cet aliment."

Forel, 1923: "Pour nourrir leurs larves les *Messor* détachent des portions de graines qu'ils portent dans le nid" (p. 38) (= 1928, Vol. II, p. 217: "To feed their larvae, the *Messor* ♀ detach portions of seeds, which they bear into the nest.") "Les larves sont alimentées par les ♀, soit par la régurgitation du contenu de leur jabot, soit par la présentation directe de la pâte en question" (p. 41). (= 1928, Vol. II, p. 220: "The ♀ feed the larvae either by regurgitating the contents of their crop, or by directly presenting the aforesaid paste.")

Stärcke, 1948, p. 26 and 28: "The caudal extremity more swollen. The duct of the labial glands broader and its epithelium composed of taller cylindrical cells."

Wheeler, 1928*a*, p. 202 (= 1926, p. 243): The larvae are fed on fragments of seeds but the very youngest larvae and the older queen and soldier larvae are fed on regurgitated food.

Messor barbarus (Linnaeus)

(Pl. I, figs. 14-20)

Stout, diameter greatest at the fifth abdominal somite, diminishing gradually toward the anterior end and rapidly to the posterior end which is broadly rounded. Thorax curved ventrally. Lateral longitudinal

welts feebly developed. Anus ventral. Leg, wing and gonopod vestiges present. About eight differentiated somites. Spiracles small, the first slightly larger. A few minute spinules in short transverse rows on the dorsal surface of the last few abdominal somites. Body hairs sparse and very short. Of three types: (1) minute to very short (0.006-0.045 mm), stout, tapering rapidly to a sharp point, generally distributed; (2) much longer (0.027-0.09 mm), lanceolate, on the prothorax; (3) stout with frayed tip, about 0.07 mm long, a few on the prothorax. Head moderately large; cranium subhexagonal in anterior view, about as long as broad. Antennae small, with three sensilla each. Head hairs moderately numerous, short (0.012-0.045 mm), stout, spike-like. Labrum small, short (width 2⅓× the length), narrowed dorsally, feebly bilobed; anterior surface of each lobe with 1-4 minute hairs and/or sensilla; on the ventral border of each lobe are 3-5 sensilla; posterior surface with a cluster of four sensilla on each half; posterior surface spinulose, the spinules minute and arranged in short arcuate rows which tend to form a reticulate pattern. Mandibles small; moderately sclerotized; apex slender and curved medially; no medial teeth; basal half of medial surface bearing several long spinules; anterior and posterior surfaces with a few rows of minute spinules. Maxillae lobose; palp a short stout peg with 4-5 sensilla; galea a slender frustum bearing two apical sensilla. Labial palp a low elevation bearing one small and four larger sensilla; opening of sericteries a short transverse slit. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in subtransverse rows. (Material studied: numerous larvae from Tunis, labelled var. *politus*.)

Eidmann, 1926: "Jedes Korn war wie eine kleine Schüssel oder ein Becher mehr oder weniger tief ausgehöhlt, und in der Höhlung hatte jedesmal eine Larve ihren Kopf stecken. Dies war durch die starke, hakenförmige Ventralkrümmung des Kopfes der Larve besonders leicht möglich. Es ist kaum zweifelhaft, dass diese Larven gerade beim fressen waren und die Löcher in den Körnern genagt hatten. Vielleicht hatten auch die Arbeiter die Körner erst angefressen und dann den Larven zur weiteren Mahlzeit vorgelegt. Es ist damit wohl ausser Frage gestellt, dass die Körnervorräte der *Messor*-Ameisen als Larvennahrung Verwendung finden. Damit soll nicht gesagt sein, dass sie nicht auch von den Arbeitern gefressen werden, nur wird man diesen Vorgang beim Öffnen eines Nestes nicht sehen, sondern lediglich im künstlichen Nest verfolgen können" (p. 719). Fig. 8 (p. 720) shows seeds gnawed by larvae. Eidmann referred to this ant as *M. instabilis* var. *bouvieri* Bondr.

Emery, 1912, p. 113: "Coi frammenti di pasta rammolliti dalla malassazione in bocca delle formiche, esse alimentano, almeno in parte, le larve. Si vedono le larve grandicelle applicare la bocca sulla pasta molle, come farebbero sopra altra esca. Non vi è dunque bisogno alcuno di procedere alla confezione, lunga e complicata, del 'pane delle larve' del Neger, poichè le larve del *Messor* mangiano direttamente la pasta

rammollita; senza dubbio farebbero lo stesso del frumento, e di qualsiasi altro seme sminuzzato e impastato con la saliva delle operaie, perocchè la pasta per minestra è semplicemente farina di frumento impastata e disseccata, senza intervento di fermenti, e ancora meno di funghi.''

Emery, 1915, p. 185: ''Le formiche granivore alimentano anche le loro larve coi semi, sia col rigurgito del contenuto dell'ingluvie, sia col porgere a queste larve i frammenti di semi imbevuti di saliva; spesso vedo, nel nido artificiale, operaie della Formica dei cortili portare in bocca una o due larve, attaccate ad un frammento di grano masticato.'' (Translated by Wheeler and Bailey, 1920, pp. 251-252: ''The granivorous ants also nourish their larvae with seeds, either in the form of the regurgitated contents of the crop, or in the form of seed-fragments saturated with saliva and directly administered. In an artificial nest I have also seen a worker of the court-yard ant carrying in her mouth one or two larvae attached to a piece of masticated seed.'')

Fahringer and Tölg (1912, pp. 249-250) recorded the eucharid wasp *Eucharis adscendens* Fabricius as reared from the cocoons of this ant. Since myrmicine larva do not spin cocoons, the identification of the ant host is suspect. (Same host cited by Gösswald, 1932, p. 38 and 1934/35, p. 142 and by Ruschka, 1924, p. 84.)

Forel, 1923, p. 43: ''Une partie des graines germées et pelées est travaillée en masses pâteuses. A un certain moment ces masses sont sorties du nid en grande quantité et placées au séchage à l'air, comme les graines mouillées. Elles ressemblent beaucoup à des miettes de pain noir . . . Neger est persuadé que ce pain de fourmis sert aux *Messor* de provision de réserve et surtout d'aliment pour les larves. Emery demeure sceptique.'' (= 1928, Vol. II, pp. 222-223: ''Part of the material of the peeled and germinated seeds is worked up into masses of paste. At a certain moment a large number of these are taken out of the nest and laid out in the air to dry, like the damp seeds. They look very much like crumbs of black bread . . . Neger is convinced that the *Messor* use this ant-bread as a reserve-stock, and more particularly as food for the larvae. Emery remains skeptical.'') (Also discussed by Escherish, 1917, p. 158.)

Gantes, 1949: ''La jeune larve est très petite, 0 mm. 75, et en forme de poire. Le bout de l'abdomen est la partie la plus large et s'amincit régulièrement vers le thorax; la tête est plus large que le thorax. Le corps est nu; la 3^{e} paire de stigmates est plus grande les autres. La larve du 5^{e} stade est en poire, avec le bout de l'abdomen large, arrondi, anus subterminal, la tête fine. Les segments sont nettement séparés. Le corps est couvert de petits poils, 0 mm. 023, simples et très espacés. Ils sont plus denses sur la tête et le prothorax. La tête est bien différenciée. Le labre, qui comprend deux lobes, ne recouvre pas les mandibules. Dorsalement, six petits poils sont répartis en file parallèle au bord antérieur, de chaque côté de l'échancrure, et quatre plus grands en arrière. Ventralement, près du bord antérieur, on a un groupe de quatre

sensilles sur chacun et une isolée plus externe. Les mandibules sont de simples triangles de 0 mm. 106 de long. Les maxilles, proéminents, portent deux palpes sensoriels et six poils autour des palpes dont quatre minuscules. Le palpe distal est un cône court dont le sommet est occupé par deux petites sensilles à soies très courtes. Le palpe proximal, presque aussi long; plus large, est creusé d'un sillon depuis le bout jusqu'à mi-hauteur; au fond de ce sillon on trouve une sensille, les quatre autres étant au sommet. Le labium, proéminent, est garni de six poils minuscules autour de chaque palpe, qui ont cinq sensilles dont deux sans soies'' (pp. 79-80). Growth data, p. 86. Pl. III, fig. II, larva in ventral view; fig. II, young larva. Pl. IV, mandible, labrum and labial palp.

Neger (1910): See Forel and Emery (1912) above.

Stäger (1929) proved (by actual observation under a microscope) that the larvae of this species are able to feed directly upon seeds without any previous preparation by the workers.

Messor barbarus aegyptiacus (Emery)

Athias-Henriot, 1947: internal anatomy—pp. 254, 256, 257, 260 and Fig. 3. Bernard, 1948, p. 107: internal anatomy.

Messor barbarus minor (Ern. André)

Emery, 1912, p. 108: ''Le uova delle operaie schiudono, ma le larve che derivano da quelle uova, quando divengono grandi, sono molto differenti dalle larve solite: si gonfiano, diventano, per così dire, idropiche . . . Sono larve di maschi, e sono d'aspetto differente dalle larve delle femmine e delle operaie; dunque. . .vi è un dimorfismo larvale in relazione col dimorfismo sessuale.''

Messor barbarus semirufus (Ern. André)

Fahringer (1922, p. 42) recorded the eucharid wasp *Eucharis punctata* Förster from the cocoons of *M. b. s.* var. *concolor* Emery. Since myrmicine larvae do not spin cocoons, the identification of the ant host is suspect.

Messor barbarus striaticeps (Ern. André)

(Pl. II, figs. 21-25)

Similar to *barbarus* except in the following characters: About 12 differentiated somites. Body hairs of three types: (1) minute to very short (0.009-0.045 mm), with the tip denticulate, generally distributed; (2) longer (0.054-0.13 mm), with the tip denticulate, numerous on the prothorax and near the posterior end of the abdomen, a few in a band around the middle of other somites; (3) simple, flexible, slender, longer (0.054-0.14 mm), restricted to the anterior portion of the ventral surface of the prothorax. Head hairs rather long (0.054-0.09 mm) and stout, with a few denticles near the tip. (Material studied: numerous larvae from Tunis, labelled var. *striatula*.)

Messor barbarus structor (Latreille)

Goetsch, 1937, p. 807: The larvae are fed with solid food, but the longer life cycle makes interruptions probable. Hence intermediate workers are produced. The life cycle is given as—egg 24-46 days, larva 16-36 days, pupa 13-28 days.

Meyer, 1927: "27. Mai. Das Weibchen sitzt zusammengekrümmt in der oberen Erdkammer des Nestes vor dem Eipaket mit 5-6 kleinen Lärvchen. Es legt binnen weniger als 1 Minute ein Ei, das es zwischen die mandibeln nimmt, anbeisst und, mit leichtem Drucke den Inhalt ganz allmählich wie aus einem Gummiballe hervorpressend, den Lärvchen der Reihe nach hinreicht. Dabei wird eine jede Larve zuerst mit den Fühlern betastet und durch Betrillern der Seiten des Vorderkörpers zum Fressen angeregt. Erst wenn die bis dahin Vollkommen regungslose Larve Kopf und Mundteile zu bewegen beginnt, hält das Weibchen ihr das Ei direkt an den Mund, worauf die erstere sofort zu saugen beginnt. Nach einer Weile nimmt das Weibchen ihr das Ei ab, hält es der zweiten Larve hin, dann einer dritten usw. So machte es unter allen Larven mehreremal die Runde, bis der ganze Inhalt des Eies aufgezehrt war, was im ganzen eine halbe Stunde in Anspruch nahm. . .17. Juni. Die Mutterameise sitzt vor dem Eipaket mit Larven von verschiedener Grösse und füttert diese mit einem eben gelegten Ei. Sie legt das Ei zuerst einer grösseren Larve nach Betrillern mittels der Fühler auf die nach oben gekehrte Bauchseite dicht hinter den zurückgebeugten Kopf und die Larve beginnt nun selbständig zu fressen. Das Weibchen hebt darauf die Larve mit dem Ei vom Eipaket, legt dieselbe daneben hin und lässt sie drei Minuten lang saugen. Um auch die übrigen Larven zu speisen, nimmt es das Ei der ersten Larve mit Gewalt ab, da sich diese an demselben mit ihren Kiefern festgebissen hatte. Nun wurde das angefressene Ei unter jedesmaligem Betrillern mittels der Fühler der Reihe nach drei weiteren, jedoch kleineren Lärvchen mit den Mandibeln und Vorderfüssen vor den Mund gehalten, wobei eine jede von ihnen 2-4 Minuten lang fressen durfte, bis der ganze Inhalt des Eies erschopft war" (p. 283). Larvae also ate the following food supplied by the author: bread crumbs; seeds of *Lepidium ruderale*, from which the hard outer shell had been removed; flies, which were cut to pieces by the workers. This food is simply laid in a pile among the larvae, which seem to be able to get hold of it independently. The life cycle (in artificial nests) is given as —egg 24-26 days, larva 16-36 days, pupa 13-28 days.

Wheeler, 1928*a*, p. 202: "Meyer (1927) . . . finds that the recently fecundated queens of several ants (notably *Messor structor*) while establishing their colonies not only devour many of their own eggs but also feed them to their first brood of larvae."

Messor rufotestaceus (Förster)

Athias-Henriot, 1947, pp. 256, 260, 264: internal anatomy.

Genus **Novomessor** Emery

Body hairs moderately numerous and short. Of two types (with intergrades on the metathorax): (1) most are bifid, with the long branches curled away from each other; (2) a few on prothorax, mesothorax and abdominal somites IX and X are straighter and have bifid or multifid tip. Antennae very small. Head hairs moderately numerous, rather short, with bifid or multifid tip. Posterior surface of labrum spinulose, the spinules minute and mostly in short arcuate rows which tend to form a reticulate pattern. Mandibles with the apex forming a long slender round-pointed tooth which is strongly curved medially; the two medial teeth are prominent and round-pointed; no spinules. Maxillae not spinulose. Labium sparsely spinulose. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in subtransverse rows.

Novomessor albisetosus (Mayr)

(Pl. II, figs. 26-31)

Body hairs moderately numerous, short. Of two types: (1) most are bifid with the long branches curled away from each other, about 0.125 mm long; (2) a few on prothorax, mesothorax and abdominal somites IX and X are straighter, 0.025-0.15 mm long, with bifid or multifid tip; intergrades occur of the metathorax. Cranium subhexagonal in anterior view but with the angles indistinct; as long as broad. Antennae very small, with three sensilla each. Head hairs moderately numerous, rather short (0.045-0.09 mm), with bifid or multifid tip. Labrum short (width 2X length), bilobed; anterior surface of each lobe with 8-9 sensilla and/or minute hairs; ventral border of each lobe with two contiguous sensilla and a few spinules; posterior surface of each lobe with a cluster of three sensilla and 4-5 isolated sensilla; posterior surface spinulose, the spinules minute and mostly in short arcuate rows which tend to form a reticulate pattern. Mandibles moderately sclerotized, subtriangular in anterior view, the apex forming a long slender round-pointed tooth which is strongly curved medially; the two medial teeth are prominent and round-pointed. Maxillae with the apex paraboloidal; palp a short, stout peg with four apical and one lateral sensilla; galea digitiform with two apical sensilla. Labium with the anterior surface sparsely spinulose, the spinules minute and in short subtransverse rows; on the anterior surface near the base is a hemispherical bulge; palp a low elevation with five sensilla; opening of sericteries a short transverse slit. Dorsal portion of the hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in subtransverse rows. (Material studied: ten damaged integuments from Arizona and Texas.)

Genus **Pheidole** Westwood

Worker.—Plump, chunky and subellipsoidal; head ventral, near the anterior end, mounted on a small short neck formed from the anterior

portion of the prothorax; anterior end broadly rounded, formed from the dorsa of prothorax and mesothorax. Body hairs sparse and mostly short. Of three types: (1) short, bifid, generally distributed; (2) on the dorsal surface of the mesothorax, metathorax and abdominal somites VI-X a few longer hairs with bifid tip; (3) anchor-tipped, long, with tortuous shaft, 2-4 in a row across the dorsum of each abdominal somite I-V. Head moderately large. Head hairs few, short, with the tip bifid. Posterior surface of labrum spinulose, the spinules minute and mostly in transverse rows. Mandibles rather small; apex forming a moderately long slender tooth which is curved medially and posteriorly; medial border with three stout blunt teeth surrounding a denticulate cavity; anterior surface with a few coarse denticles on the middle half. Maxillae with a few spinules on the apex. Anterior surface of labium rather densely spinulose, the spinules minute and in subtransverse rows of various lengths. Hypopharynx sparsely spinulose, the spinules minute and in transverse rows.

Soldier.—Similar to worker, but with the body longer (by about 40%) and larger and the head relatively smaller.

Queen.—About twice as long as worker; body voluminous and turgid; head relatively very small. Body hairs simple; a few on the prothorax; elsewhere exceedingly minute and widely scattered. Head hairs very short, sparse and simple. Otherwise similar to worker larva.

Male.—About 70% longer than worker; body voluminous and turgid. Head relatively smaller. Body hairs bifid, short, exceedingly scarce. Head hairs few, bifid, short. Otherwise similar to worker larva.

Clausen, 1940, p. 221: The eucharid wasps of the genus *Orasema* appear to be most frequently associated with *Pheidole* and *Solenopsis.* (Eucharid larvae are parasitic on ant larvae.)

Gantes, 1949, p. 88: Sexual larvae are quite different from worker larvae. The larvae of *Pheidole* are able to eat food which the workers have placed near them.

Stärcke, 1948, p. 28: "Body still more swollen, of a short oval or nearly globose shape, with a small head projecting on the ventral side."

Wheeler, 1910*a*, p. 421: "Thus the ectoparastitic *Orasema* [Eucharidae] larva extracts important juices from the body of the *Pheidole* larva directly and with great rapidity, thereby reducing its host to a mere skin, which, though still able to pass on to the pupal stage, no longer possesses sufficient substance or vitality to reach the imaginal stage."

Pheidole dentata Mayr

(Pl. III, figs. 1-14)

Worker.—Length about 2.3 mm. Plump, chunky and subellipsoidal; head ventral, near the anterior end, mounted on a small short neck formed from the anterior portion of the prothorax; anterior end broadly rounded, formed from the dorsa of the prothorax and mesothorax. Anus posteroventral. Leg, wing and gonopod vestiges present. Segmentation indistinct. Spiracles small, the first slightly larger. Integument of the

ventral surface of the thorax and abdominal somites I-III sparsely spinulose, the spinules minute and in short transverse rows. Body hairs sparse, uniformly distributed and without alveolus and articular membrane. Of three types: (1) bifid, short (0.036-0.072 mm), generally distributed; (2) on the dorsal surface of the mesothorax, metathorax and abdominal somites VI-X are a few longer (0.027-0.10 mm) hairs, with bifid tip; (3) anchor-tipped, long (about 0.25 mm), with tortuous shaft, four in a row across the dorsum of each abdominal somite I-V. Head moderately large; cranium suboctagonal but with the angles inconspicuous, about as long as broad. Antennae small, each with three sensilla. Head hairs few, rather short (0.036-0.07 mm), with bifid tip. Labrum small, short (width 2½× length), slightly narrowed dorsally, ventral border with two ventrolateral lobes separated by a median plane; anterior surface of each half with 4-5 sensilla and/or minute hairs; ventral border with one isolated and two contiguous sensilla on each half; ventral border with a few coarse isolated spinules; posterior surface of each half with 2-3 isolated and 2-3 contiguous sensilla; posterior surface spinulose, the spinules minute and mostly in transverse rows. Mandibles rather small, moderately sclerotized; subtriangular in anterior view; apex forming a moderately long, slender tooth which is curved medially and posteriorly; medial border with three stout blunt teeth surrounding a denticulate cavity; anterior surface with a few coarse denticles on the middle half. Maxillae with the apex paraboloidal and spinulose, the spinules few, minute and in short arcuate rows; palp a skewed peg with three apical and two lateral sensilla; galea digitiform with two apical sensilla. Labium with the anterior surface rather densely spinulose, the spinules minute and in subtransverse rows of various lengths; palp a low irregular elevation with five sensilla; opening of sericteries a short transverse slit hidden in a shallow depression. Hypopharynx sparsely spinulose, the spinules minute and in transverse rows.

Soldier.—Length about 3.1 mm. Very similar to the worker except for the larger size of the body. The head, although actually a trifle larger, is relatively smaller.

Very Young.—Length about 0.62 mm. Diameter greatest at abdominal somite III, tapering rapidly to a narrow posterior end, constricted at the mesothorax. Body hairs sparse; more numerous on the prothorax, diminishing gradually to two each on abdominal somites VIII-X. Of two types: (1) with bifid tip, 0.018-0.036 mm long; (2) simple, with flexible tip, 0.009-0.018 mm long. Dorsal surface of posterior somites sparsely spinulose. Antennae very small.

Young.—Length about 0.8 mm. Body hairs somewhat longer than in very young, with bifid tip. Dorsal surface of posterior somites sparsely spinulose. Mandibles with all teeth stout, short and round-pointed; no spinules found. Maxillae apparently without spinules; palp a low irregular elevation bearing five sensilla; galea a short truncate cone bearing two apical sensilla. Otherwise similar to the mature worker larva.

Young.—Length about 1.0 mm. Generally similar to mature larva.

Queen.—Length about 4.6 mm. Body voluminous and turgid. Integument thin. Head actually a third larger than that of the worker, but very small in comparison with the body. Body hairs simple; a few on the prothorax which are very short (0.009-0.018 mm); elsewhere exceedingly minute and widely scattered. Dorsa of posterior somites sparsely spinulose, the spinules minute and in short transverse rows. Head hairs very short (about 0.009 mm), sparse and simple. Labrum subtrapezoidal, narrowed ventrally; ventral border slightly concave. Mandibles with the subapical teeth more acute. Otherwise as in the worker larva.

Male.—Length about 3.8 mm. Body voluminous and turgid. Integument thin. Head about equal in size to that of the worker but smaller in relation to body size. Body hairs sparser. Labrum subrectangular in anterior view, with the ventral corners rounded and the ventral border slightly concave. Mandibular teeth more acute. Otherwise similar to worker larva.

Immature Sexual.—Length about 2.8 mm. Similar to mature sexual larva except that the body is more inflated. It differs from the soldier larva of the same length by having the head and neck directed anteroventrally, by appearing much more inflated and by having the contours smooth.

Material studied: numerous larvae from three Texan colonies.

Van Pelt (1950) recorded larvae of the eucharid *Orasema robertsoni* Gahan as parasitic on the larvae and pupae of this ant. Fig. 1A showed an ant larva in side view with a eucharid larva attached.

Wheeler (1901) inferred that the larvae of macroĕrgates of this species (cited as *Ph. commutata*) had been infested with *Mermis* (Nematoda) while in the larval stage. (Also discussed by Wheeler: 1907, p. 18; 1910*a*, p. 420; 1910*b*, p. 420; 1928*a*, p. 204 (= 1926, p. 247); 1928*b*, p. 197.)

Wheeler (1907, p. 20) stated that this species (cited as *Ph. commutata*) "is exclusively carnivorous and feeds at least its older larvae with pieces of insect food." On page 12 he reported finding *Orasema viridis* in *dentata* colonies. Presumably the eucharid larvae had been parasitic on the ant larvae.

Pheidole absurda Forel

Emery (1904) discussed mermithergates of this species and inferred that the nematode larvae were parasitic in the ant larvae. (Referred to by Wheeler, 1907 and 1928*a*, p. 204 (= 1926, p. 248).)

Pheidole ceres Wheeler

Wheeler (1907, p. 14) recorded *Orasema wheeleri* Ashmead from the nest of this ant; presumably the eucharid larva had been parasitic on an ant larva.

Pheidole fabricator (F. Smith)

Eidman, 1936: "Die jungen Larven sind dicht behaart mit gegabelten

Acrochaeten, . . . die auf der Dorsalseite von langen, gekrümmten und in ankerförmige Spitzen auslaufenden Oncochaeten überragt werden. Demgegenüber sind die Altlarven mit Ausnahme des Kopfes so gut wie unbehaart. Auch ihre Gestalt ist sehr eigenartig. Sie erscheinen zu dicken eiförmigen Körpern aufgebläht, an denen die Segmentierung verwischt und nicht mehr zu erkennen ist, und an welchen der relativ kleine Kopf wie ein winziges Anhängsel sitzt, überragt von dem mächtig aufgetriebenen Prothorax. Diese Altlarven sind ihrer Grösse nach vermutlich Larven von Geschlechtstieren'' (p. 40). Fig. 2d (p. 43) shows a mature larvae in side view.

Pheidole flavens Roger

Wheeler, G. C. and E. W., 1937: The larvae of the eucharid *Orasema costaricensis* G. C. & E. W. Wheeler are parasitic on the larvae of this ant. Pl. I, figs. 5, 6 and 10 show relation of eucharid larva to host larva. (Referred to by Clausen, 1940, p. 227.)

Pheidole hyatti Emery

Cranium transversely subelliptical; head hairs shorter. Otherwise similar to worker larva of *dentata*. (Material studied: one larva from Oklahoma.)

Pheidole kingi instabilis Emery

Generally similar to worker larva of *dentata* except in the following characters: Body hairs about twice as numerous (but still sparse); shorter; anchor-tipped hairs only two each on abdominal somites I-V. Cranium transversely subelliptical in anterior view, a third broader than long; head hairs shorter (about 0.018 mm long). Mandibles shorter and stouter, with the median teeth larger and more divergent. Soldier and male larvae are also similar to those of *dentata*. (Material studied: numerous larvae from Texas.)

Wheeler, 1900*a*: ''The very young larvae have only simple bifurcated hairs, but when half-grown they have on the dorsal surface of several of the segments, besides a much greater number of these simple bifurcated hairs, several rows of long and peculiarly contorted bristles, terminating in short bifurcations'' (p. 21), Fig. 10 on p. 21: ''*a*, very young larva; *b*, furcate bristle of same; *c*, half-grown larva; *d*, contorted furcate bristle of same.'' (Figure repeated Wheeler, 1910, as Fig. 43 on p. 77). We have a note in Dr. W. M. Wheeler's handwriting referring to the above-mentioned larvae: ''erroneously described and figured as *Solenopsis geminata!*''

Wheeler, 1907: ''Small, spherical, sexual larvae, fed with regurgitated liquids'' (p. 6). Pl. V, fig. 64, photograph showing queen and worker larvae. ''The larvae of all the castes are provided with several pairs of flexuous, anchor-tipped dorsal hairs, by means of which they may be temporarily fixed to the earthen walls of the chambers or to the rough surfaces of the stone covering the nest. While in this position they are fed by the workers with bits of crushed seeds or insect fragments in

the same way as the larvae of the Ponerine ants. At least the younger larvae of the males and females, however, appear to be fed largely, if not exclusively, with regurgitated liquid food'' (p. 4). The eucharid *Orasema viridis* Ashmead was discussed (pp. 2-12) but Wheeler stated (p. 6) that the female wasp had ''nothing to do with the *instabilis* larvae but directs her attention to the pupae.''

Wheeler, 1910*a*: ''I have seen the workers . . . feeding the larvae directly with pieces of crushed seeds'' (p. 279). The young larva of the eucharid wasp *Orasema viridis* Ashmead ''attaches itself to the neck of the ant-larva, sucking out its juices and in the course of a few days undergoing several ecdyses, pupating and hatching, without necessarily withdrawing sufficient substance from the ant-larva to prevent its pupating in turn. But such larvae have nevertheless lost much of the material which in uninfested individuals goes to form the head, thorax and eyes of the adult, so that these parts are very poorly developed in the pupae. These pupae, which I have called phthisergates, phthisogynes and phthisaners . . . never hatch'' (p. 418). Also discussed in Wheeler, 1928*a*, p. 203 (= 1926, p. 246).

Pheidole megacephala (Fabricius)

Generally similar to the worker larva of *dentata* except in the following characters: Body hairs about twice an numerous (but still sparse); anchor-tipped hairs only two each on abdominal somites I-V. Cranium transversely subelliptical in anterior view; head hairs shorter (0.018-0.036 mm) and with multifid tip. (Material studied: 14 larvae from Rarotonga.)

Reichensperger (1913, p. 213) reported the larva of the eucharid *Psilogaster fraudulentus* Reichensperger as ectoparasitic on the larva of this ant.

Pheidole nitidula Emery

Gemignani (1933, p. 491) has recorded the eucharid *Orasema doellojuradoi* Gemignani from a nest of this ant. It is possible that the eucharid larvae had been parasitic in the ant larvae.

Pheidole nodus F. Smith

Generally similar to the worker larva of *dentata* except in the following details: Body hairs twice as numerous (but still sparse); somewhat longer. Mandible somewhat larger; apical tooth longer; all teeth sharper. (Material studied: six larvae from Japan.)

Pheidole opaca apterostigmoides Weber

Weber (1945, p. 31) found larvae of this species ''stuck by their hairs to the sides and ceiling of the cell.''

Pheidole pallidula (Nylander)

Athias-Henriot (1947): internal anatomy—pp. 257, 260, 266 and Fig. 3 on p. 256.

Berlese, 1902, pp. 241-253: "Le larve più piccole . . . misuravano 1,350μ. Più grosse, più molli e carnose di quelle prima vedute, mostrano ancora il primo segmento toracico molto prodotto all'innanzi, così che il capo è infero o subinfero" (p. 241). "Larva di circa 2 mill. Le variazioni avvenute nella configurazione generale si limitano alla maggiore protrusione all'innanzi del primo anello del corpo, al di sopra del capo" (p. 242). The remainder treats of internal anatomy, as do also Figs. 58, 59, 60 and 61. Fig. 60 is repeated as Fig. 949 in Berlese, 1909.

Emery, 1918, p. 71: "Questa esperienza porta alle conclusioni seguenti: 1. Le larve dei soldati sono allevate con cure speciali molte operaie le coprono, e verosimilmente le alimentono per degurgito. 2. Le larve dei maschi sono allevate e alimentate allo stesso modo. 3. Verosimilmente le uova, che si sono sviluppate in maschi, sono state deposte da soldati. 4. Quantunque, in questa esperienza, non siano state allevate femmine, è presumibile che le larve, destinate a diventare tali, sarebbero soggette alle stesse cure ed allo stesso regime di quelle dei soldati e dei maschi." (Mentioned by Wheeler, 1937, p. 49.)

Gantes, 1949: "a) *Sexués:* elles sont beaucoup plus grosses que les larves d'ouvrières et en diffèrent également par la forme. Une larve de femelle au 5^e stade mesure 8 mm., elle est très blanche et a la forme d'un oeuf: on ne distingue plus aucun segment qui soit séparé par une fine ligne blanche, seuls la tête et le prothorax se voient, car ils sont perpendiculaires au corps, le prothorax servant de cou. Ils n'ont pas été envahis par le corps gras comme le reste. Le corps est nu sauf le premier segment thoracique, la tête et la partie ventrale du mésothorax, sous la tête. La tête est longue, recouverte de poils simples. Le labre est formé de trois lobes: le lobe du milieu s'avançant à peine en avant des deux autres: il porte sur sa face ventrale deux groupes de trois sensilles, et chaque lobe latéral une sensille. Toute la surface interne est tapissée de poils courts qui sont par petits groupes et en rangs transversaux, formant un dessin réticulé. Ceci se trouve chez tous les genres sans exception, les poils étant plus ou moins grands. Les mandibules sont des triangles, mais à base moins large, et vers le sommet les bords tendent à devenir parallèles. L'apex est une dent émoussée, plus longue que celle qui se branche sur sa face interne; plus bas on en voit deux autres égales. Toute la zone interne est tapissée de petites dents émoussées. Ces mandibules sont petites: 0 mm. 078. Le labium porte des palpes de cinq sensilles.

"b) *Ouvrières:* ces larves sont beaucoup plus petites, 1 mm. 95, subcylindriques avec la tête repliée sur le ventre. Elles diffèrent surtout par les poils qui sont nombreux et de plusieurs types. La tête est identique. 1. *Poils à double crochet,* très longs, 0 mm. 20. Ils sont très souples et peuvent s'allonger grâce à un ressort en forme d'S. Ils sont placés en cinq rangs de deux poils sur le dos et à partir du premier segment abdominal. 2. *Poils fourchus* de 0 mm. 05, droits, sur le thorax et sur les côtés de l'abdomen. 3. *Poils fourchus,* plus courts, 0 mm. 041 et 0

mm. 032, répartis sur tout le corps. La fourche est légèrement plus grande. 4. *Poils simples,* de 0 mm. 041, répartis sur tout le corps'' (pp. 80-81). Pl. III: outline of sexual larva; hairs of worker. Pl. IV: mandible and labrum.

Goetsch, 1937*a*: If the larvae receive during a certain short period solid food so concentrated that they can grow suddenly, they develop into soldiers. The larvae must not be older than five days; if older they develop into workers regardless of food. The critical days are the fourth and fifth. The food must be rich in protein, e.g., pieces of insects, and it must be solid. Liquid food is dispensed by the workers, a little to each larva; thus no one larvae gets the unusual abundance required. The worker must lie beside the piece of food and feed independently. By interrupting the feeding during the critical period the author was able to produce small soldiers and also intermediates between small soldiers and workers—forms which do not occur naturally. Fig. 4 shows worker larvae and a soldier larva (repeated 1937*b*, p. 11). The life cycle was found to be: egg 7-12 days, larva 5-12 days, pupa 8-13 days, total 25-33 days (p. 803).

Vandel (1927, p. 44) maintained that ''le *Mermis* [Nematoda] ne pénètre pas dans la larve de *Pheidole, mais seulement dans la pronymphe au moment de la nymphose.*'' The same viewpoint was maintained in 1930. (See also Wheeler, 1928*b*.)

Pheidole pallidula arenarum Ruzsky

Menozzi, 1936: ''*Larva matura del soldato.*—Colore biancastro, col capo e con le parti rinforzate del tegumento di colore melleo, le mandibole uniformemente color crema e le setole biancastre. Il corpo è vescicoloso a contorno pressochè circolare, appena più lungo che largo, un poco ristretto nella parte anteriore, coi segmenti più o meno distinti e con una leggera protuberanza nell'ultimo urosternite, sulla quale si apre l'ano a forma di fessura. Nelle larve mature, o quasi, l'ipocefalia è appena accennata, mentre le giovani, sono nettamente ortocefale. Il capo è libero e relativamente molto piccolo rispetto al corpo. La capsula cefalica, vista dorsalmente, ha forma subcircolare, ed è un poco più larga che lunga, coi lati e col margine posteriore arrotondati e fornita di diverse setole semplici . . . Le antenne sono, come al solito, segnate da due placche rotonde, ciascuna delle quali ha quattro sensilli, tre dei quali sono posti entro la superficie di ognuna delle placche, mentre il quarto è situato al di fuori e anteriormente ad esse. Il clipeo è troncato anteriormente e senza limite ben distinto posteriormente. Il labbro superiore è assai più stretto del clipeo, di forma subtrapezoidale, coi lati appena convessi, col margine anteriore leggermente crenulato e provvisto di 6 setole alquanto più piccole di quelle del cranio; nella faccia ventrale (palato) esso ha numerose formazioni tegumentali, a forma di squame semilunare, disposte trasversalmente in serie regolari, ed una diecina di sensilli placoidei reggruppati nella porzione mediana, lungo il margine anteriore. Le mandibole sono di un terzo più lunghe

della loro larghezza prossimale e tridentate. Le mascelle hanno ognuna una sola setoletta posta davanti al palpo mascellare. Questi è di forma cilindrica e generalmente un poco più corto del processo distale della mascella, che ha la medesima forma del palpo; entrambi sono forniti all'apice rispettivamente di 4 e 3 sensilli. Il labbro inferiore ha la parte anteriore trasversa, col margine libero subarrotondato, provvisto sulla medesima linea submediana trasversale di sei setolette, delle quali, le due di mezzo, sono un poco più lunghe di quelle laterali. I palpi labiali hanno la medesima forma di quelli mascellari, soltanto un poco più grossi e con 5 sensilli all'apice. Tutto il corpo della larva è fornito di numerose setolette semplici, senza alcuna aptocheta al dorso. Sistema tracheale olopneustico con 10 paia di spiracoli. Lunghezza della larva matura mm. 2, larghezza mm. 1, 7. *Larva dell'operaia.*—Colore pressapoco simile a quello della larva del soldato, il cranio è un poco più colorato e le mandibole, distalmente, sono ferruginee. La larva, sia giovane che matura, è nettamente ipocefala . . . e coi segmenti abbastanza distinti. Il cranio, è subcordiforme, più largo che lungo, con gli angoli occipitali fortemente arrotondati e col margine posteriore pressochè diritto. Complessivamente il capo risulta più grosso di quello della larva del soldato ed è fornito di un paio di setole semplice in più, cioè 28 (26 nel soldato). . . . Le antenne hanno soltanto tre sensilli circoscritti entro l'area delle placche, le quali, sono di forma ovale. Il clipeo è troncato anteriormente e leggermente concavo, senza setole e senza alcuna altra formazione tegumentale. Il labbro superiore è pressapoco simile a quello della larva del soldato, col margine anteriore distintamente crenulato, con 4 setole nella linea trasversale in prossimità della base, eguali a quelle del capo, e con altre due più piccole, collocate ai lati della linea mediana longitudinale, presso il margine anteriore. Le mandibole sono robuste, due volte più lunghe della loro massima larghezza e tridentate; il dente apicale è lungo quasi il doppio dei due subapicali e assai aguzzo. Il corpo mascellare ha lo stipite coi lati convessi e fornito apicalmente di due peluzzi. Il palpo mascellare è di forma cilindrica ed un poco più corto del processo distale mascellare, il quale, è alquanto rigonfio alla base, per cui la sua forma è piuttosto troncoconica. Ambedue queste appendici sono fornite all'apice di tre sensilli. Il labbro inferiore sembra sprovvisto di setolette, ed ha palpi labiali di forma eguale a quelli mascellari e, come questi, con tre sensilli all'apice. Tutto il corpo della larva è provvisto di numerose setolette biuncinate e di qualche altra, sparsa qua e là, semplice; gli urotergiti 2-6 hanno inoltre, ciascuno, da 3 a 4 aptochete. Sistema tracheale simile a quello della larva del soldato. Lunghezza della larva adulta mm. 1, 8-2" (pp. 280-283). Fig. VIII on p. 281: young and mature soldier larvae in side view; head in anterior view, enlarged; mandible, enlarged. Fig. IX on p. 282: mature worker larva in side view: head in front and side views, enlarged; mandible, enlarged; three hairs, enlarged. This ant is referred to var. *orientalis* Emery.

Pheidole pilifera (Roger)

Probably similar to the worker larva of *dentata* except in the following details: Body hairs longer; anchor-tipped hairs four on each abdominal somite I-VI. Labrum as in subspecies below. (Material studied: A dozen damaged integuments from New Jersey.)

Pheidole pilifera subsp.

Generally similar to the worker larva of *dentata* except in the following characters: Body hairs twice as numerous (but still sparse); slightly shorter. Head hairs slightly shorter (0.027-0.045 mm long). Labrum not quite so short (breadth slightly less than twice the length); subrectangular; ventral border with a small median notch; anterior surface with a median longitudinal groove. Mandibles with the apical tooth more curved and the medial teeth more divergent. Soldier and male larvae are also similar to those of *dentata*. (Material studied: numerous larvae from North Dakota.)

Pheidole proxima Mayr

Brues (1934, p. 203) reported *Eucharomorpha wheeleri* Brues from nests of this ant. Presumably the eucharid larvae had been parasitic in the ant larvae.

Pheidole punctulata Mayr

Weber, 1948, pp. 32-33: "To the lower surface of the rock the ant larvae were attached by their long dorsal hairs. Many of the larvae were holding pieces of termites, sufficiently held that they stayed on the larvae when the rock carrying them was roughly overturned. . . They were held on the ventral surface next to the mouthparts. . . Later study showed that the larvae were held to the rock by a few long dorsal hairs, each terminating in a pair of hooks. The hairs grew directly from the body at right angles, then made a complete, irregular loop before proceeding by several irregular curves to their bifurcated apices. In addition there were much shorter and finer dorsal hairs, also bifurcated apically. The termite fragments were held in place by the bent head against the body, assisted by a few simple hairs on the ventral surface."

Pheidole sciophila Wheeler

Wheeler (1907, p. 12) recorded this ant as a host of the eucharid *Orasema viridis* Ashmead. Presumably the eucharid larvae had been parasitic in the ant larvae.

Pheidole sitarches Wheeler

Wheeler, 1910*a*, p. 279: "I have seen the workers . . . feeding the larvae directly with pieces of crushed seeds."

Pheidole strobeli Emery

Gemignani (1933, p. 489) recorded a eucharid wasp (*Orasema argen-*

tina Gemignani) found in the nest of this species (''var. *misera* Sant.''). Presumably the eucharid larvae had been parasitic in the ant larvae.

Pheidole strobeli silvicola Borgmeier

Eidmann, 1936, p. 41: ''Dabei fiel . . . die Trennung der Larven in 2 Grössenklassen, ganz junge und grosse Altlarven, auf, letztere vermutlich überwinterte Larven, erstere von der ersten Eiablage des Frühjahres stammend. Die Larven zeigen eine ähnliche dichte Behaarung, wie sie oben für die Junglarven von *Ph. fabricator* beschrieben wurde.''

Pheidole vasliti Pergande

Mann (1914, p. 184) recorded this species (var. *acolhua* Wheeler) as the host of the eucharid wasp *Orasema tolteca* Mann. Presumably the eucharid larvae had been parasitic in the ant larvae.

Pheidole vinelandica Forel

Wheeler (1907, pp. 13-14) recorded this species as a host of the eucharid wasp *Orasema coloradensis* Ashmead. Presumably the eucharid larvae had been parasitic in the ant larvae.

Pheidole sp.

Girault (1915, p. 230) recorded the eucharid wasp *Orasema pheidolophaga* Girault from the pupae of this ant. Presumably the eucharid larvae had been parasitic in the ant larvae.

Wheeler (1900*b*, p. 68) ''found dozens of larvae feeding on fragments of different insects collected and comminuted by the workers.''

Genus **Ischnomyrmex** Mayr

Plump and chunky; anterior end formed from the dorsa of prothorax and mesothorax. Body hairs moderately numerous and mostly short. Of three types: (1) short, bifid, generally distributed; (2) longer, bifid-tipped, on the dorsal surface of the thorax and posterior abdominal somites; (3) long, anchor-tipped, with tortuous shaft, four in a row across the dorsum of each abdominal somite I-V. Antennae very small. Head hairs few, rather short, with bifid tip. Posterior surface of labrum spinulose, the spinules minute and arranged in subtransverse rows on the middle half and in sublongitudinal rows on the lobes. Mandibles thin and sinuous in profile; apical tooth, long, slender, bent medially near the tip, sharp-pointed; with two stout blunt medial teeth and one smaller and sharper; coarse spinules on the basal half of the anterior surface and on the medial surface near the apex. Maxillae and labium without spinules; galea a slender frustum. Dorsal portion of hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in numerous subtransverse rows.

Ischnomyrmex longipes (F. Smith)

(Pl. III, figs. 15-21)

Plump and chunky; anterior end formed from the dorsal surface of the

prothorax and mesothorax; head on the ventral surface near the anterior end. Anus subterminal. Spiracles small, the first slightly larger. Body hairs moderately numerous, uniformly distributed. Of three types: (1) bifid, short (0.054-0.12 mm), without alveolus and articular membrane, generally distributed; (2) on the dorsal surface of the thoracic somites and posterior abdominal somites are a few longer (0.14-0.22 mm) hairs with bifid tip, without alveolus and articular membrane; (3) anchor-tipped, long (about 0.44 mm), with tortuous shaft, four in a row across the dorsal surface of each abdominal somite I-V. Cranium suboctagonal in anterior view; slightly broader than long. Antennae very small, each with two or three sensilla, each of which bears a rather long spinule. Head hairs few, rather short (0.035-0.07 mm), with bifid tip. Labrum small and short (breadth 2X length), slightly narrowed dorsally, ventral border with two prominent ventrolateral lobes separated by an indistinct medial lobe; anterior surface of each half with four minute hairs and/or sensilla; ventral border with three sensilla on each half; ventral border spinulose, the spinules minute and in short rows; posterior surface of each half with two isolated and a cluster of three sensilla; posterior surface spinulose, the spinules minute and arranged in subtransverse rows on the middle half and in sublongitudinal rows on the lobes. Mandibles moderately sclerotized, narrowly subtriangular in anterior view, thin and sinuous in profile; apical tooth long, slender, bent medially near the tip, sharp-pointed; medial border with two stout blunt medial teeth and one smaller and sharper; coarse spinules on the basal half of the anterior surface and on the medial surface near the apex. Maxillae lobose; palp a skewed peg with one lateral, one subapical and three apical sensilla; galea a slender frustrum with two apical sensilla. Labial palp a low irregular elevation with five sensilla; opening of sericteries a short transverse slit. Dorsal portion of the hypopharynx with sublongitudinal ridges; ventral portion spinulose, the spinules minute and in numerous subtransverse rows. (Material studied: two damaged integuments from Borneo).

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